Resistencia de Materiales 6-1

Monday, April 15, 2019 9:30 AM

Problemas varios:

EXAMPLE 1.11

If the wood joint in Fig. 1–23*a* has a width of 150 mm, determine the average shear stress developed along shear planes *a–a* and *b–b*. For each plane, represent the state of stress on an element of the material.

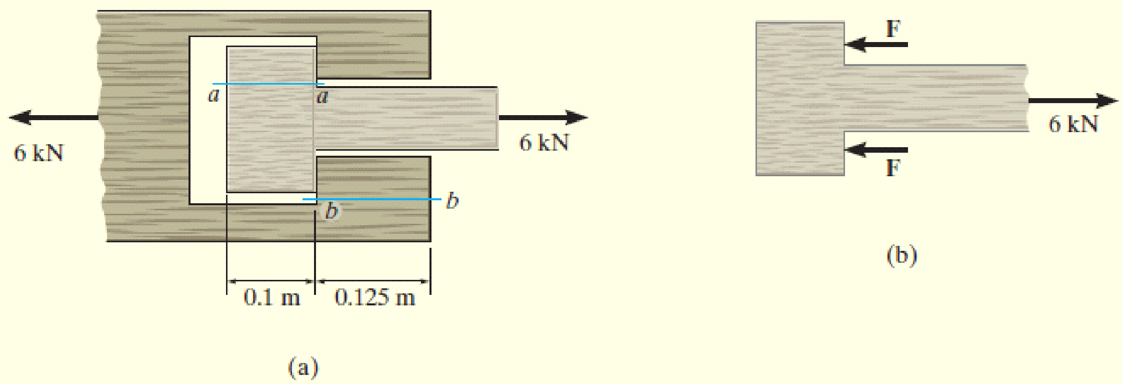


Fig. 1–23

SOLUTION

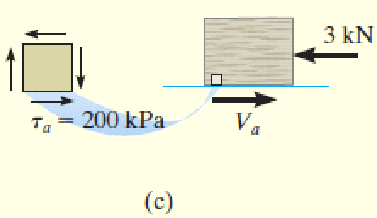
Internal Loadings. Referring to the free-body diagram of the member, Fig. 1–23*b*,

$$\overset{+}{\rightarrow}\Sigma F_x = 0; \qquad 6\text{ kN} - F - F = 0 \qquad F = 3\text{ kN}$$

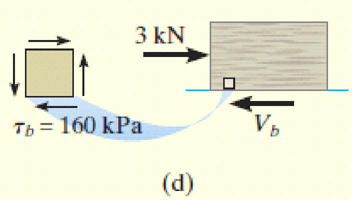
Now consider the equilibrium of segments cut across shear planes *a–a* and *b–b*, shown in Figs. 1–23*c* and 1–23*d*.

$$\overset{+}{\rightarrow}\Sigma F_x = 0; \qquad V_a - 3\text{ kN} = 0 \qquad V_a = 3\text{ kN}$$

$$\overset{+}{\rightarrow}\Sigma F_x = 0; \qquad 3\text{ kN} - V_b = 0 \qquad V_b = 3\text{ kN}$$



(c)



(d)

Average Shear Stress.

$$(\tau_a)_{\text{avg}} = \frac{V_a}{A_a} = \frac{3(10^3)\text{ N}}{(0.1\text{ m})(0.15\text{ m})} = 200\text{ kPa} \qquad \textit{Ans.}$$

$$(\tau_b)_{\text{avg}} = \frac{V_b}{A_b} = \frac{3(10^3)\text{ N}}{(0.125\text{ m})(0.15\text{ m})} = 160\text{ kPa} \qquad \textit{Ans.}$$

The state of stress on elements located on sections *a–a* and *b–b* is shown in Figs. 1–23*c* and 1–23*d*, respectively.

EXAMPLE 2.4

The plate shown in Fig. 2–7*a* is fixed connected along AB and held in the horizontal guides at its top and bottom, AD and BC. If its right side CD is given a uniform horizontal displacement of 2 mm, determine (a) the average normal strain along the diagonal AC, and (b) the shear strain at E relative to the x, y axes.

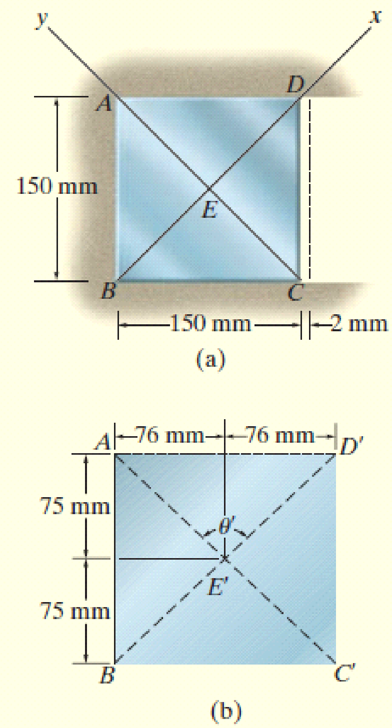


Fig. 2–7

SOLUTION

Part (a). When the plate is deformed, the diagonal AC becomes AC', Fig. 2–7*b*. The length of diagonals AC and AC' can be found from the Pythagorean theorem. We have

$$AC = \sqrt{(0.150\text{ m})^2 + (0.150\text{ m})^2} = 0.21213\text{ m}$$

$$AC' = \sqrt{(0.150\text{ m})^2 + (0.152\text{ m})^2} = 0.21355\text{ m}$$

Therefore the average normal strain along the diagonal is

$$(\epsilon_{AC})_{\text{avg}} = \frac{AC' - AC}{AC} = \frac{0.21355\text{ m} - 0.21213\text{ m}}{0.21213\text{ m}}$$

$$= 0.00669\text{ mm/mm} \qquad \textit{Ans.}$$

Part (b). To find the shear strain at E relative to the x and y axes, it is first necessary to find the angle θ' after deformation, Fig. 2–7*b*. We have

$$\tan\left(\frac{\theta'}{2}\right) = \frac{76\text{ mm}}{75\text{ mm}}$$

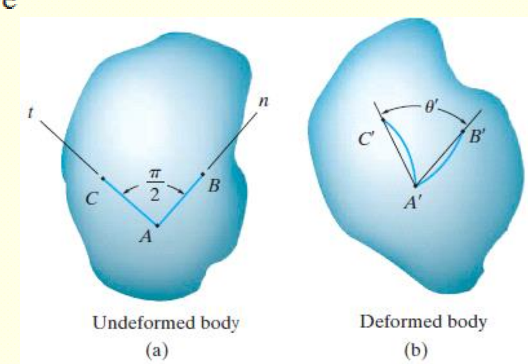
$$\theta' = 90.759^\circ = \left(\frac{\pi}{180^\circ}\right)(90.759^\circ) = 1.58404\text{ rad}$$

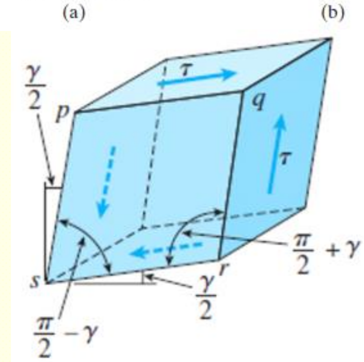
Applying Eq. 2–3, the shear strain at E is therefore

$$\gamma_{xy} = \frac{\pi}{2} - 1.58404\text{ rad} = -0.0132\text{ rad} \qquad \textit{Ans.}$$

The *negative sign* indicates that the angle θ' is *greater than* 90°.

NOTE: If the x and y axes were horizontal and vertical at point E, then the 90° angle between these axes would not change due to the deformation, and so $\gamma_{xy} = 0$ at point E.





Ejercicios de repaso:

Book: Mechanics of Materials
Author: R. C. Hibbeler
Edition: 8
Problems: 1-33, 1-34, 1-37, 1-38, 1-48, 1-51, 1-53, F2-4, 2-4, 2-6, 2-19, 2-20